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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/516,300	12/09/2004	Gino Palumbo	BROO300	5590
23364	7590	07/07/2010	EXAMINER	
BACON & THOMAS, PLLC			LEADER, WILLIAM T	
625 SLATERS LANE				
FOURTH FLOOR			ART UNIT	PAPER NUMBER
ALEXANDRIA, VA 22314-1176			1795	
			MAIL DATE	DELIVERY MODE
			07/07/2010	PAPER

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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 10/516,300

Filing Date: December 09, 2004

Appellant(s): PALUMBO ET AL.

Eric Spector
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed April 8, 2010, appealing from the Office action mailed November 27, 2009.

(1) Real Party in Interest

The examiner has no comment on the statement, or lack of statement, identifying by name the real party in interest in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The following is a list of claims that are rejected and pending in the application: Claims 1-8 and 10-34 are finally rejected.

(4) Status of Amendments After Final

The examiner has no comment on the appellant's statement of the status of amendments after final rejection contained in the brief.

(5) Summary of Claimed Subject Matter

The examiner has no comment on the summary of claimed subject matter contained in the brief.

(6) Grounds of Rejection to be Reviewed on Appeal

The examiner has no comment on the appellant's statement of the grounds of rejection to be reviewed on appeal. Every ground of rejection set forth in the Office action from which the appeal is taken (as modified by any advisory actions) is being maintained by the examiner except for the grounds of rejection (if any) listed under the subheading "WITHDRAWN REJECTIONS." New grounds of rejection (if any) are provided under the subheading "NEW GROUNDS OF REJECTION."

(7) Claims Appendix

The examiner has no comment on the copy of the appealed claims contained in the Appendix to the appellant's brief.

(8) Evidence Relied Upon

3,929,595	Biberbach et al.	12-1975
4,088,544	Hutkin	5-1978
5,433,797	Erb et al.	7-1995
6,743,346	Gonzalez et al.	6-2004
7,378,004	Uzoh et al.	5-2008

Lowenheim, F. A. "Electroplating" (1978), pp. 139-140.

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

1. Claims 1-8, 10-12, 15, 17, 27-31, 33 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Erb et al (US 5,433,797) in view of the Lowenheim text *Electroplating* and additionally in view of Biberbach et al (US 3,929,595) and Gonzalez et al (6,743,346).
2. The Erb et al patent (hereinafter Erb) is directed to the electrodeposition of metallic materials in nanocrystalline form. This is the same field of endeavor to which appellant's claims are directed. Erb discloses that nanocrystalline nickel having a grain size of less than 11 nanometers, and selected pure metals, binary, ternary and quaternary alloys thereof having a grain size of less than about 100 nanometers may be produced (column 1, lines 13-19). This range of less than 100 nanometers for grain size is the same range recited by appellant in independent claims 1, 31 and 33. Figure 1 of Erb illustrates the apparatus used to carry out the process. Element 3 is an anode and element 6 is a cathode (column 3, line 56 to column 4, line 13). Electric current is supplied to deposit the selected metallic material in nanocrystalline form on the cathode (column 2, line 51 to column 3, line 2). As shown in the examples, an aqueous electrolyte containing ions of metal(s) to be deposited was provided. This corresponds to step (a) recited in claim 1. In example 7, Erb discloses that the electrolyte was stirred continuously at 0-500 rpm. This would have provided agitation of the electrolyte and corresponds to step (b) recited in claim 1. Instant claim 10 recites that agitation is produced by means of pumps, stirrers or ultrasonic agitation. Thus, the stirring of Erb produces agitation in the same manner as agitation is produced in appellant's claimed process.

3. Claims 1, 31 and 33 differ from the process of Erb by reciting a deposition rate of at least 0.05 mm/h and agitating the electrolyte at an agitation rate of 0.0001 to 10 liter per minute per cm² anode or cathode area. While the process of Erb as exemplified in example 7 has a deposition rate and agitation rate, Erb is silent as to numerical values of these rates.

4. The Lowenheim text *Electroplating* discusses the importance of mass transport in an electrodeposition process. As metal is deposited upon a cathode, the solution in its immediate neighborhood is depleted in metal ions. If plating is to continue, these ions must be replenished. This may be accomplished by convention which involves the movement of substantial quantities of the solution relative to the electrodes. The electrodes may move, the solution may move, or both. The cathodes may be agitated by commercially available rod agitators, the solution may be stirred by propellers, or it may be pumped through heat exchangers for both temperature control and agitation. See page 139. It is again noted that instant claim 10 recites that agitation is produced by means of pumps, stirrers or ultrasonic agitation. Lowenheim shows that the production of agitation by means of pumps and stirrers is conventional.

5. The Biberbach et al patent (hereinafter Biberbach) is directed to the electrodeposition of gold with a high rate of deposition. Gold is one of the metals recited in instant claim 4. Biberbach discloses that gold may be deposited at a rate of 1 μm (0.001 mm) in 0.75 to 1.5 minutes (0.04 to 0.08 mm/hr) depending on the agitation of the bath (column 3, lines 8-11). Thus, Biberbach recognizes that agitation affects the rate of deposition. In example 4, the articles being plated were provided with a motion of 4 cm/sec. The deposition of a coating 8 μm thick took place in 10 minutes (0.048 mm/hr). In example 5, the composition and temperature were the same as in example 4, but the article motion was 25 cm/sec. It took 48 seconds to

deposit a coating 1 μm thick (0.075 mm/hr). These examples show that increased agitation allows a higher deposition rate to be obtained.

6. The Gonzalez et al patent (hereinafter Gonzalez) is directed to the electrochemical deposition of palladium or its alloys. Palladium is one of the metals recited in instant claim 4. Gonzalez teaches that the process can be applied where it is sought to work at the maximum deposition rate. To obtain high productivities, the baths have to operate at the highest possible current density and a high temperature, and a high agitation rate is often necessary (column 6, lines 48-54). In example 2, a palladium-nickel alloy is deposited. Agitation was vigorous to very vigorous. The deposition rate at a current density of 28 A/dm² was 1 μm in 10 seconds (0.36 mm/h).

7. The prior art or record is indicative of the level of skill of one of ordinary skill in the art. It would have been obvious at the time the invention was made to have utilized an appropriate amount of agitation of the bath in the process of Erb to have achieved a deposition rate of at least 0.05 mm/h because relative motion between the solution and article being plated, which serves as the cathode electrode, improves mass transport and replenishment of metal ions in the vicinity of the cathode as taught by Lowenheim, and agitation provides increased deposition rates which result in increased process efficiency as shown by Biberbach and Gonzalez. Both Biberbach and Gonzalez disclose the use of agitation to achieve deposition rates which fall within the range recited in instant claim 1. As shown by the references, agitation is a result-effective variable. Choice of an appropriate amount of agitation would have been a matter of routine optimization. See MPEP 2144.05 II.

8. Claim 27 is dependent on claim 1 and recites in paragraph (b) single or multiple pulses in a frequency range which includes 0 Hz, and an off time period range which includes 0 msec. These two limitations include non-pulsed direct current. Paragraph (c) recites an anodic time period range which includes 0 msec. This limitation also includes non-pulsed direct current. Paragraph (d) recites a duty cycle which includes 100%. This similarly includes non-pulsed direct current. Thus, claim 27 includes the use of straight direct current as well as pulsed current. With respect to claim 27, Erb discloses the use of direct current or pulsed direct current (column 3, lines 53-54). The pulsed current may have a peak current density between about 0.1 and 3.0 A/cm², an on time of about 0.1 to 5 milliseconds, and an off time of about 1 to about 500 milliseconds. See column 2, lines 62-68. These values fall within the ranges recited by applicant.

9. With respect to claim 28, Erb discloses that the electrolyte is maintained at a temperature of between about 15 to 75 °C. This range falls within the range recited in claim 28.

10. With respect to claims 2 and 3, as noted above, Erb discloses peak current densities falling within applicant's recited ranges.

11. With respect to claim 4, Erb discloses deposition of pure metals and alloys including many of those recited by applicant such as Co, Cr, Cu and Fe. See column 3, lines 3-13. With respect to claim 29 which is dependent on claim 4, Erb discloses that it is known to deposit nickel-phosphorus (column 2, lines 19-20).

12. With respect to claim 5, Erb teaches the use of periodic pulse reversal. The reverse pulse would have included an anodic time period (column 6, lines 34-37). Pulse parameters are result effective variables. Choice of appropriate parameters would have been a matter of routine

optimization. With respect to claims 6 and 7, Erb discloses pulse plating parameters which provide a duty cycle and frequency within the ranges recited by applicant (column 2, lines 62-68 of Erb)

13. With respect to claim 8, each of Biberbach and Gonzalez discloses a deposition rate falling within the range recited.

14. With respect to claim 10, as noted above, Erb discloses the use of a stirrer while Lowenheim teaches the use of pumps or stirrers to provide agitation. With respect to claims 11 and 15, as noted above, Lowenheim discloses agitating the cathodes using a commercial rod agitator. With respect to claim 12, the amount of agitation is a matter of routine optimization.

15. With respect to claim 17, Erb discloses the inclusion of a stress relieving agent such as saccharin, coumarin, sodium lauryl sulfate and thiourea. See column 4, lines 51-56.

16. With respect to claim 30, Erb discloses that the formation of an alloy of Fe with Ni is known (column 2, lines 18-19).

17. With respect to claim 31, as noted above, Erb discloses the use of cathodic current pulses.

18. Claims 16, 18-25 and 32 rejected under 35 U.S.C. 103(a) as being unpatentable over Erb et al (US 5,433,797) in view of the Lowenheim text *Electroplating* and additionally in view of Biberbach et al (US 3,929,595) and Gonzalez et al (6,743,346) as applied to claims 1-12, 15, 17, 27-31 and 33 above, and further in view of the admitted prior art.

19. The prior art is that found in applicant's specification under the heading "Description of prior art/background of the invention".

20. With respect to claim 16, the admitted prior art includes Icx1 patent 2,961,395 which discloses using a hand-manipulated applicator that serves as an anode and has a wick (absorbent separator) containing the electrolyte. It would have been obvious to have utilized a hand-manipulated applicator as taught by Icx1 to have carried out the process suggested by Erb because an article could be plated without the necessity of immersing it into a plating tank.

21. With respect to claim 18, the admitted prior art includes Mori patent 5,496,463 which discloses composite electroplating in which solid particles are introduced in fine form into the electrolyte. It would have been obvious to have included particulate material in the process of Erb because the properties of the deposit would have been improved. With respect to claims 19-23, the amount and size of particulate material are result-effective variables which affect the characteristics of the coating. Choice of an amount of particulates to have included in the deposit would have been a matter of routine optimization.

22. With respect to the product of claims 24, 25 and 32. The admitted prior art includes the recognition that micromechanical systems (MEMS) have overall dimensions ranging from 1 to 1000 μm . As noted above, Erb discloses the formation of deposits with a grain size of less than 11 nanometers. In example 6, the grain size was 6 nm. Formation of a micromechanical device having the grain size produced by the process of Erb in a size taught by the admitted prior art would have resulted in the ratio between maximum dimension of the device and grain size recited as recited by applicant.

23. Claims 13 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Erb et al (US 5,433,797) in view of the Lowenheim text Electroplating and additionally in view of

Biberbach et al (US 3,929,595) and Gonzalez et al (6,743,346) as applied to claims 1-12, 15, 17, 27-31 and 33 above, and further in view of Uzoh et al (US 7,378,004).

24. Claim 13 recites that the relative motion is achieved by rotation of anode and cathode relative to each other. The Uzoh et al patent (hereinafter Uzoh) is directed to an electrodeposition process. Uzoh teaches that the substrate holder may be rotated to aid electrolyte agitation and enhance mass transfer. See column 1, lines 61-64. It would have been obvious at the time the invention was made to have rotated the substrate in the process of Erb et al to have provided agitation. Choice of the amount of agitation would have been a matter of routine optimization. See MPEP 2144.05 II.

25. Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Erb et al (US 5,433,797) in view of the Lowenheim text *Electroplating* and additionally in view of Biberbach et al (US 3,929,595), Gonzalez et al (6,743,346) and the admitted prior art as applied to claims 16, 18-25 and 32 above, and further of Hutkin (US 4,088,544).

26. Claim 26 additionally specifies that the component has an equiaxed micro structure. The Hutkin patent is directed to a process for making copper foil by electroplating. The copper deposited during the electroplating can be controlled so as to favor the formation of either columnar crystals or equiaxed crystals (column 5, lines 14-18). It would have been obvious to have chosen plating parameters to have formed an equiaxed deposit in the process of Erb et al as shown by Hutkin depending on the desired properties of the component being formed.

(10) Response to Argument

At page 5 of the Brief, appellant argues that the rejections are defective because they do not teach or make obvious applicant's limitation for agitation of 0.0001 to 10 liters per minute per cm² anode or cathode area, which applicant points out is agitation rate normalized to electrode area. By normalizing agitation rate to electrode area, appellant's limitation requires a greater amount of agitation for larger anode or cathode electrodes, and a lower amount of agitation for smaller electrodes. Appellant is correct that none of the references explicitly set forth a normalized agitation rate. However, Erb, Biberbach and Gonzalez all utilize agitation of the electrolyte in contact with the electrodes during electrodeposition. The anode and cathode electrodes of Erb, Biberbach and Gonzalez have a finite area, so that as the process of each of the references is carried out, there is an inherent value of normalized agitation rate even if it is not specified.

At page 6 of the Brief, appellant argues that the Examiner takes the position that agitation rate normalized to electrode area is considered to be a way of expressing an amount of agitation but that there is no source cited as evidence for this conclusion. The units specified in appellant's claims are liters per minute per square centimeter. These units indicate that the amount of agitation is expressed in liters of electrolyte agitated. This is measured over a period of time expressed in minutes. The Examiner has provided the dictionary definition of "rate" which is "a quantity, amount or degree of something measured per unit of something else" (Merriam-Webster's Dictionary of Law, 1996). Thus agitation rate is the amount of agitation (expressed in liters) measured per unit of time (expressed in minutes). Agitation rate clearly relates to the amount of agitation. Appellant normalizes or scales this rate with respect to

electrode area in square centimeters, i.e., mathematically divides by electrode area. The actual agitation rate (liters/minute) used in the agitating step of the claimed process is the normalized agitation rate (liters/minute-cm²) multiplied by the area of the anode(s) or cathode(s) in cm².

Normalizing may or may not change the numerical value of agitation rate. If the anode or cathode electrode is 1 square centimeter in size, the numerical values of actual agitation rate and normalized agitation rate are the same. Normalizing does not alter the fact that agitation rate pertains to the amount of agitation as shown by the dictionary definition.

At the top of page 6 of the Brief, appellant argues that the Examiner has taken the position that agitation rate per electrode area is the same as agitation rate without reference to anode or cathode area, that the “divided by” has been ignored. It is the position of the Examiner that agitation rate normalized to electrode area is qualitatively the same as agitation rate. As taught by Erb, agitation may be created by a stirrer. Lowenheim teaches that agitation may be created by the use of a pump or a stirrer. Appellant recites in claim 10 the use of a pump or a stirrer to create the agitation. The qualitative aspect of movement of the electrolyte in contact with the electrodes created in appellant’s process by a stirrer or pump is the same as the movement of the electrolyte by a stirrer or pump in the processes taught by the references. The Examiner recognizes that normalized agitation rate may be quantitatively different than agitation rate which is not normalized if the area of the cathode or anode electrode is different than 1 square centimeter. However, it is also noted that in appellant’s example 1 the electrolyte circulation rate is described as “vigorous agitation.” Lowenheim describes the movement of “substantial quantities of the solution relative to the electrodes.” In example 2 (column 9, lines 7-8), Gonzalez describes the use of “vigorous to very vigorous” agitation. Thus, even though the

references do no provide numerical values of agitation rate or normalized agitation rate, they characterize the amount of agitation in the same way as appellant, clearly suggesting that the amount of agitation is at least similar. It is also noted that by disclosing movement of substantial quantities of the solution *relative to the electrodes*, Lowenheim suggests that more agitation would be needed to move substantial quantities if the electrodes area was large than would be needed if the electrode area was small.

At the top of page 7 of the Brief, appellant argues that the rejection seems to imply the claims require a high rate of agitation. This is incorrect. The position of the Examiner is not that appellant's claims *require* a high rate of agitation, but that the claims *include* within their scope a high rate of agitation such as the vigorous agitation described by the references. The Examiner recognizes that the numerical range recited by appellant covers five orders of magnitude per cm² of anode or cathode area, and ranges from a low rate of agitation to high rate of agitation. Lowenheim and Gonzalez suggest a high rate of agitation. As noted above, Erb discloses the use of a stirrer rotating at 0-500 rpm. The lower end of this rpm range would have produced a low rate of agitation. Thus, the references show that it is known employ agitation ranging from a low rate to a high rate.

At page 7 of the Brief appellant argues that Lowenheim with high agitation has not stated that he gets nanocrystalline structure; rather Lowenheim applies stirring to prevent concentration and temperature gradients. This argument is not persuasive because the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious.

See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985).

Appellant's claims recite a deposition rate of at least 0.05 mm/h. As explained above, Biberbach and Gonzalez teach that deposition rate depends on agitation and suggest the use of a high agitation rate to achieve high deposition rates. Thus, the references do explicitly suggest the use of agitation to achieve one of the same results claimed by appellant. Lowenheim provides the theoretical explanation for this dependence of deposition rate on agitation. As metal is deposited on the cathode, the solution in its immediate neighborhood is depleted in metal ions. If plating is to continue, these ions must be replenished. Convection through agitation is the important factor in replenishing the metal near the cathode. See page 139.

At the bottom of page 7 to the top of page 8 appellant argues that there is no support for the position on the technical issue as to whether normalized agitation rate is the same as general agitation rate, i.e. stirring to remove concentration gradients in the electrolyte and expressed, e.g., in liters per minute. As explained above, stirring (agitation rate) expressed in liters per minute may or may not be numerically the same as normalized agitation rate expressed in liters per minute per cm² of anode or cathode area depending on the actual area of the cathode or anode.

At page 8 of the Remarks, appellant refers to the declaration of Professor Erb. In paragraph 7 of the declaration, Professor Erb states that the purpose of the stirring in example 7 of Erb was to remove concentration gradients and temperature gradients in the electroplating bath and that the purpose was not to control microstructure grain size of an electrodeposit so it is nanocrystalline. As previously observed, the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See MPEP 2145 II

which states that “*prima facie* obviousness is not rebutted by merely recognizing additional advantages or latent properties present in the prior art.”

In paragraph 8 of the declaration, Professor Erb states that stirring is a different property from agitation rate normalized to electrode area, and recitation thereof does not constitute a recognition that electrolyte flow, irrespective of electrolyte uniformity must be scaled to electrode size as a parameter for controlling microstructure grain size in an electrodeposit. However, no evidence has been provided to support this conclusion, or to demonstrate that the five order of magnitude range recited in the claims provides an actual amount of agitation which yields unexpected results. It is the Examiner’s position that that by disclosing movement of substantial quantities of the solution *relative to the electrodes*, Lowenheim suggests that more agitation would be needed to move substantial quantities if the electrode area was large than would be needed if the electrode area was small. Based on the teaching of the references, agitation rate is recognized as a result-effective variable. One of ordinary skill in the art would have been capable of optimizing agitation rate for electrodes of different sizes.

Appellant presents as evidence allowed claims from the EPO, German Patent Office and Canadian Intellectual Property Offices and states that all concluded that agitation rate normalized to electrode area is different from amount of agitation. This evidence is not persuasive. It is not possible to surmise the reasons for the allowance of the claims simply by reading the claims themselves. It is noted that claim 1 of the EP 1 516 076 does not recite any limitation related to agitation.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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